

# Release of hydrogen sulfide in a refinery with transboundary effects

2 September 2008

**Antwerp  
Belgium**

Release  
Refinery  
Hydrogen sulfide  
Power failure  
Victims  
Communication  
Transboundary effects

## THE FACILITIES INVOLVED

### The site:

The plant at which the incident occurred is a refinery in Antwerp. It produces fuels like propane, butane, LPG, benzene, kerosene and gas oil, and chemical products like hexane, heptane, benzene, toluene and others.

The capacity of the refinery is 13.5 million tons a year.

The plant is situated at the eastern riverbank of the river Schelde to the north of Antwerp about 6 kilometers south of the border between Belgium and The Netherlands.

Electrical power is supplied to the refinery by two 36 kV power lines.



## THE ACCIDENT, ITS CHRONOLOGY, EFFECTS AND CONSEQUENCES

### The accident:

The morning of September the second, maintenance work was planned by the company that supplies the electrical power to the refinery. The two power lines had proved to be fragile and it was planned to replace the connections in both power lines. To that order one of the power lines was shut of at 11.56 am.

A plan to do this had been communicated beforehand, and it was tested that the remaining power supply would have enough capacity to transmit the necessary electrical power.

At 11.57, whilst maintenance work was being carried out at one of the two the electrical power supply lines, the remaining second supply line failed, thus rendering the refinery without electrical power supply.

At 11.57, start of the execution of the emergency plan, implying emergency shut down of the refinery, evacuating all not necessary personnel and retaining only the emergency staff and starting of the emergency power supply to restart the central operating desk.

At 12.00, product stream is led to torch, leading to large flame and release of soot (carbon black) to the atmosphere.

At the same time opening of several safety valves emitting several kinds of hydrocarbons to the atmosphere among which Benzene. Also H<sub>2</sub>S (hydrogen sulphide) is emitted.

At 12.14, the Antwerp environmental services are by fax informed of the incident with an emergency shut down. No assistance was deemed necessary by the operator or the environmental services.

At 12.30, assistance of emergency services is requested by neighboring companies because of large soot deposits on their sites and respiratory problem of some of their personnel.

At 12.41, arrival of the emergency services at the site. They are informed of the incident.

At 13.00, the crisis staff of the ministry of the interior of the state of Belgium is informed about the incident.

At 17.15, the supply of electrical power is restarted, and preparations are started to restart the refinery.

**Consequences of the accident:**

In the first minutes of the incident a safety valve opened and released 70 kilograms of hydrogen sulphide (approximately 40 m<sup>3</sup> of pure H<sub>2</sub>S gas).

The safety valve is situated at a height of about 40 meters. After the release a cloud of H<sub>2</sub>S formed, which migrated, with a speed of 45 kilometers/hour in north-north-eastern direction.

Later analysis revealed that at ground level the concentration of H<sub>2</sub>S reached about 0.6 ppm whilst in the center of the cloud the concentration was in excess of 10 ppm.

After circa 5 minutes the cloud reached inhabited areas to the north of the refinery, causing acute illness, nausea, respiratory problems and a general feeling of unwell being.

In the course of the next 70 minutes the cloud traveled about 50 kilometers over Belgium and parts of The Netherlands, affecting several hundreds of people. Fifty-seven people needed medical care, but nobody was seriously injured.

**The European scale of industrial accidents**

By applying the rating rules applicable to the 18 parameters of the scale officially adopted in February 1994 by the Member States' Competent Authority Committee for implementing the "SEVESO II" directive on handling hazardous substances, and in light of the information available, this accident can be characterised by the four following indices:

Dangerous materials released		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Human and social consequences		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Environmental consequences		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Economic consequences		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

The parameters composing these indices and their corresponding rating protocol are available from the following Website: <http://www.aria.developpement-durable.gouv.fr>

The quantity of hydrogen sulphide released to the atmosphere was evaluated at 0.070 ton. The upper classification threshold associated with this very toxic gas is set at 20 tons. Parameter Q1 is thus rated as 2 (0.07 x 100/20=0.35%).

The level 5 given to the social and human consequences is due to the 57 persons injured from the public in the Netherlands (parameter H5).

The incident had no environmental consequences and the economic consequences were not evaluated.

**THE ORIGIN, CAUSES AND CIRCUMSTANCES SURROUNDING THE ACCIDENT**

**Origin of the power failure and following emergency shut down**

Although, the plan to repair the fragile power line was tested and approved, there will remain a risk of failure, especially as in this case, half the power supply was cut under conditions of full load, thus concentrating the full load on a power line that was known to be fragile.

**Origin of ventilated H<sub>2</sub>S**

The safety valve that released about 70 kg of H<sub>2</sub>S to the atmosphere opened according to plan, in order to prevent damage to the installation under conditions of an emergency shut down.

The location of the safety valve was at sufficient height, in order to ascertain that H<sub>2</sub>S concentrations at ground level could not reach dangerous levels.

**Communication**

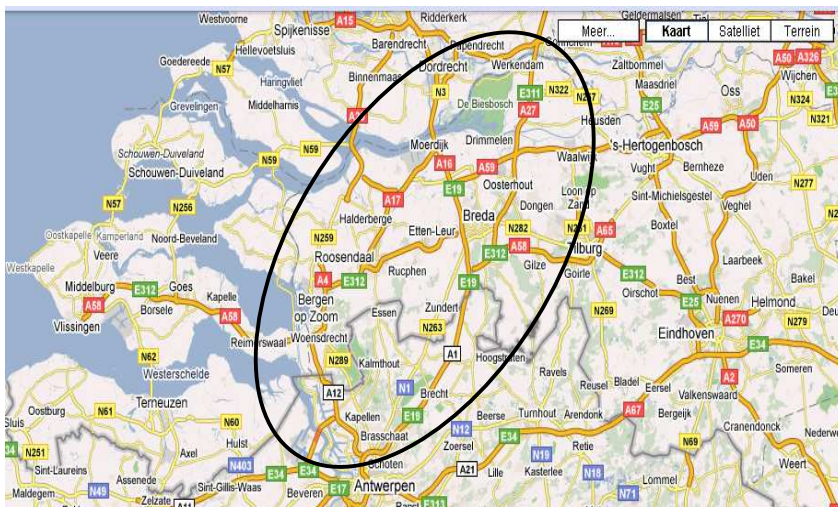
Due to the power failure, information about the status of the plant and its various parts was scarce to technicians, and in consequence during the first half hour of the incident no information was available about the nature and the amount of the emissions to the atmosphere.

As the emergency shut down was executed according to plan, no outside assistance of emergency services was deemed necessary.

As a consequence, they were not informed by the operator about the incident and the possible consequences. So during the first hour no information about the incident and the substances emitted to the atmosphere was available to local authorities or local emergency services.

It follows that also the authorities and emergency services in the affected area across the border in The Netherlands were not informed, although the Helsinki treaty obliges countries to do so. No information was made available to the public about the incident until two hours after the incident.

Several hundreds in an area up to 50 kilometers from the incident location were affected by the H<sub>2</sub>S and experienced ill effects. Fifty-seven of them needing medical care. Nobody was severely injured, and no health effects remained after the passing of the cloud.



Due to lack of information, emergency services did not know how to react and how to treat the people who sought treatment, and no information could be given to the public until two hours after the incident.

This led to public unrest and disturbance. Confidence in authorities and emergency services was damaged.

## ACTIONS TAKEN

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The incident and the communication about the incident have been evaluated by the refinery's operator itself, by the Belgian authorities and by the Dutch local, regional and national authorities.

Steps have been taken to make sure that information about incidents in the area within 15 kilometers of the national borders will be given at first notice after the incident.

International notification and communication procedures between Belgium and the Netherlands will be tested in 2009.

## LESSONS LEARNT

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The problem was not the incident in itself, but the lack of information and communication to the public, due to a lack of information about the release of H<sub>2</sub>S.

This led to public disturbance and unrest and damaged the public confidence in authorities and emergency services.

Notification and information, also across border, about an incident are a must.

Communication procedures, also across borders must be tested. And trained again and again.

Information about the risk of an incident have to be given to the public beforehand, in order to increase the ability to cope with an incident and its effects.